



# “INCORPORATING PLASTIC WASTE INTO ROAD CONSTRUCTION”

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## ABSTRACT:

Plastic waste and its disposal pose a serious risk to the environment, causing pollution and global warming. Bituminous mixes become stronger and more possessive when plastic waste is incorporated into them. It will also provide an answer for the disposal of plastic and other pavement flaws like potholes, corrugations, ruts, etc. The waste plastics that are utilized are low-density polyethylene (LDPE), high-density polyethylene (HDPE), polypropylene (PP), and polyethylene (PE). The leftover plastic is shred, covered in aggregate, combined with heated bitumen, and used to create a mixture for paving. The plastic is successfully coated over the aggregates after the aggregate mix is heated. Bitumen is heated and combined with the aggregates coated in plastic waste. This will improve the road surface's water resistance, durability, and strength of the pavement. The mechanical, chemical, and environmental performance of roads built with a 20% plastic-bitumen mixture is assessed in this review paper.

*Keywords:* plastic waste, bitumen, aggregate, strength, durability.

## I. INTRODUCTION

Bituminous base, wearing courses, and granular sub base make up the majority of the country's paved roads. Plastic is a material with many uses. Because of the industrial revolution and its widespread production[1], plastic looked to be a more accessible and practical raw material. Plastics are used in almost every significant economic sector today, including communication, electronics, building construction, agriculture, packaging, automotive, and agriculture. Plastic, which is not biodegradable, has been shown by researchers to last 4500 years on Earth before degrading. Several studies have shown the health risk that improper plastic waste disposal poses. While plastics are generally considered a friendly and useful material, improper use of them can have negative environmental effects. The current study's primary goal is to find environmentally responsible ways to dispose of different plastic and rubber wastes. Even though waste plastic is becoming a threat to both the present and the future generation, a complete ban on its use is not feasible given the state of society today. However, the use of waste plastics in road construction is becoming more and more significant these days because plastic roads perform better than conventional ones and plastic waste is believed to pose a pollution threat. can make use of it. It was discovered that covering the particles with waste plastic enhanced the bituminous mix's performance characteristics.

Additions of low density, high density, and recycled polyethylene plastic, as well as polypropylene plastic, were made to the mixture at a specific temperature. Grade 30 bitumen, regular, or plastic-coated aggregates were used to create bituminous mixtures[1]. The flexible pavement's resistance to abrasion and slippage can be greatly increased, and splitting tensile strength values that fall within the designated limits can be obtained, provided that plastic trash accounts for more than 30% of the mix weight. A consistent mixing time and temperature are crucial for the proper functioning of modified bitumen in situ. Failure to do so will lead to premature failures. Because of this, recommended mixing times, temperatures, and modifier contents are given for each polymer that is trademarked. When using waste plastic to mix and pave roads, all of this should be kept in mind. India stands to gain from the plastic road project. High temperatures and high humidity are the main advantages of long-lasting, eco-friendly plastic roads. In addition, this will help remove all plastic waste from the earth.

## II. OBJECTIVES

- To assess the feasibility of utilizing different plastic types (PE, PP, HDPE, LDPE) in road construction.
- To examine their physical and chemical properties to determine compatibility with asphalt and aggregate materials.
- To develop asphalt mixtures by varying proportions of plastic waste.
- To conduct lab tests to identify the optimal plastic content enhancing mechanical properties, durability, and sustainability.
- To compare performance with standard asphalt mixes to identify benefits or drawbacks.

## III. PLASTIC ROAD

Plastic roads are an environmentally friendly invention that use various plastic wastes, including low-density polyethylene (LDPE), high-density polyethylene (HDPE), polyethylene, and polypropylene, in the process of building new roads. This technique, which was created in India in the early 2000s, entails chopping up waste plastic and combining it with bitumen, which is the binder used in conventional asphalt[6]. The most widely used plastics are polyethylene, which is found in commonplace items like plastic bags, and polypropylene, which is used in packaging. The flexibility and durability of LDPE and HDPE plastics are well-known, and they are also essential for improving road strength. These plastics strengthen the road's resilience to deterioration when they are mixed with asphalt, making it more resilient to heavy traffic and bad weather. By utilizing plastic for roads, we can build more durable and economically viable infrastructure while simultaneously lowering the quantity of non-biodegradable waste that ends up in landfills. In comparison to traditional roads, these roads require less upkeep and have a longer lifespan[2]. The emergence of plastic roads offers a workable and sustainable solution for sustainable infrastructure, given the increasing global volume of plastic garbage.

## IV. MATERIALS

### IV.1 Plastic Waste

- Polythene (also known as polyethylene): - Polyethylene or polythene (abbreviated PE; IUPAC name polythene or poly(methylene)) is the most commonly produced plastic. It is a polymer that mostly utilized in packaging, such as bottles packaging, geomembranes, plastic bags and films.
- One of the thermoplastics that is most frequently used worldwide is polypropylene (PP). Plastic packaging, plastic components for tools and machinery, and even fibres and textiles are among the applications for polypropylene.
- HDPE or High-density polyethylene, is a thermoplastic polymer derived from petroleum. Cutting boards, shampoo bottles, bleach bottles, milk jugs, plastic bottles, and piping are just the few of the many uses of HDPE plastic, one of the most adaptable plastic available.
- Low density polyethylene or LDPE, is a lightweight, pliable and soft plastic. LDPE is renowned for its corrosion resistance, toughness and flexibility at low temperature. It is not suited for applications where stiffness, high temperature resistance and structural strength are required.

### IV.2 Bitumen

Viscosity Grade 30, or VG-30 bitumen, is a high-performance asphalt binder that is mainly utilized in hot climate areas for road construction. In comparison to conventional penetration-graded bitumen, it offers superior temperature resistance. It is graded based on its viscosity at 60°C, which ranges between 2400-3600 Poise. Dense Bituminous Macadam (DBM) and Bituminous Concrete (BC) are two examples of dense-graded bituminous mixes that can benefit from VG-30's exceptional resistance to rutting and deformation under high traffic and temperature conditions. VG-30 has a penetration value of 50–70 (0.1 mm) and a softening point between 47 and 56°C.

VG-30 has a higher viscosity than VG-10 and VG-20, which means that it will last longer, have consistent hardness, and be more resistant to weathering. Additionally, it provides excellent workability for paving, which promotes efficient building procedures. VG-30 works well in hot weather, but research is still being done to improve its environmental impact. Recycling and adding polymers to the bitumen to improve its performance are two such ways. It may not be the best choice in colder climates where cracking may be a problem, but it is commonly used in hot mix asphalt (HMA) for highways and high traffic roads. Notwithstanding these difficulties, VG-30 is still an essential component for the construction of road infrastructure.

### IV.3 Aggregate-20mm

20 mm aggregate is an essential component of pavement layers, including the base, sub-base, and surface layers, in road construction. These aggregates, which are obtained from quarries and obtained by crushing and screening procedures, are usually

made of hard rock, such as limestone, granite, or basalt, guaranteeing great strength and durability. Because it can offer drainage as well as stability, the aggregate with a size of 20 mm is preferred. It is frequently utilized in the base and granular sub-base layers of flexible pavements, where its interlocking structure increases load-bearing capacity and efficiently distributes traffic loads. It also helps keep the upper layers stable by giving them a solid base that lessens deformation from traffic loads.

In order to improve the strength, durability, and skid resistance of densely graded asphalt mixtures used in bituminous (asphalt) road construction; 20 mm aggregates are added. The road's performance and longevity are enhanced by its angular shape and rough texture, which facilitate better bitumen bonding. Aggregates need to be tested for qualities such as specific gravity, water absorption, and abrasion resistance. Maintaining appropriate grading and cleanliness is crucial for maximum efficiency, contributing to the improvement of the road's strength, stability, and lifespan.

## V. CONCLUSION

The mixed plastic with bitumen and aggregate is used for the better performance of the roads. The aggregates reduce the voids and moisture absorption. This results in the reductions of ruts and there is no pothole formation. The plastic road can withstand heavy traffic and are durable than flexible pavement or road. The use of waste plastic mix will reduce the bitumen content by 20% and increase the strength and performance of the road. This Plastic waste used into road construction is a new technology and is eco-friendly. The use of different types of plastic in the Bitumen Road construction can reduce the plastic waste by around 20 to 30% in the earth and it can also reduce the vehicular pollution.

From the above test results, it can be concluded that addition of plastic waste in the grade vg-30 bitumen significantly improves the performance of the road and it can increase the strength and durability of the road.

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